HABITAT MANIPULATION FOR REESTABLISHMENT OF UTAH PRAIRIE DOGS IN CAPITOL REEF NATIONAL PARK[1]

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Abstract.— Utah prairie dogs were transplanted onto the site of a former colony, located in Capitol Reef National Park, Utah. Shrubs on the site were significantly taller than those found on active colonies in similar habitat located on the Awapa Plateau. Therefore, the transplant site afforded a test of the hypothesis that shrub height is a major inhibitory factor affecting occupation of sites by prairie dogs. Four sites of 5 ha each were used. Vegetation treatments—rotobeating, railing, and 2,4-D herbicide—were carried out on three of the sites and the fourth was used as a control. Shrub height and percent cover were significantly reduced on all three treatment sites. Posttreatment effects on the vegetation showed that the greatest percent moisture of the herbage was found on the railed site, followed by the herbicide, rotobeaten, and control sites. Measurements of the visual obstructions to prairie dogs showed that the rotobeaten site had the greatest visibility, followed by the railed, herbicide, and control sites.

Prior to release of prairie dogs on the study area, 200 artificial burrows per treatment were dug, using a power auger. In early summer, 1979, 200 Utah prairie dogs were live-trapped near Loa, Utah. An equal number by sex and age class were released on each treatment. In 1979 a significantly higher number of animals reestablished on the rotobeaten site. In 1980 and 1981 the rotobeaten and railed sites had significantly higher prairie dog numbers than the other sites. Reproduction occurred on both the rotobeaten and railed sites in 1980 and 1981. Results indicated that, when transplanting animals onto sites of former colonies presently overgrown with shrubs, the chances of a successful transplant could be increased by first reducing shrub height and density.

The Utah prairie dog (*Cynomys parvidens*), endemic only to Utah, is presently found in six counties in the south central part of the state (Elmore and Workman 1976). Since 1920 the area occupied by the Utah prairie dog has declined by an estimated 87 percent and their numbers have also declined from an estimated 95,000 in 1920 to an actual count of 3,429 in 1976 (Collier and Spillett 1973). As a result of this decline, the Utah prairie dog was classified as an endangered species in 1968, delisted in 1972, and subsequently reinstated in 1973 (Bureau of Sport Fisheries and Wildlife 1968, 1972, 1973).

Possible reasons for the decline in population and the reduction in range of the Utah prairie dog, as listed by Collier and Spillett (1972), are: purposeful poisoning, disease, drought, shooting, predation, and habitat changes. Poisoning is thought to be the most important factor that has influenced the distribution and abundance of the Utah prairie dog in the past 45 years. Toxicants have been used to eliminate the species from approximately 8000 hectares (Collier and Spillett 1972). Population reductions corresponding to periods of intensive poisoning have occurred in 1933, 1950, and 1960. However, federal agencies have not used toxicants to control Utah prairie dogs since 1963 (Collier and Spillett 1973). Because of its classification as an endangered species, the use of toxicants for population control has been prohibited since 1968.

Prairie dogs of all species are restricted to habitat of relatively open plant communities with short-stature vegetation (Allan and Osborn 1949, Koford 1958, Fitzgerald and Lechleitner 1974, Collier 1974, Crocker-Bedford and Spillet 1977). According to Collier (1974), Utah prairie dogs prefer areas with vegetal cover shorter than 31 cm. Apparently this is due to the fact that prairie dogs are dependent upon visual surveillance of their environment to guard against predators and for intraspecific interactions (Fitzgerald and Lechleitner 1974). Prairie dogs have extended their range into areas where

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the tall, dense, native vegetation has been reduced by domestic animals and agriculture (Schaffner 1929, Osborn 1942). The converse of this has also been known to occur. A colony of prairie dogs was eliminated when tall, dense vegetation encroached a site after grazing was stopped (Allan and Osborn 1949).

The recent elimination of the Utah prairie dog in the Escalante Desert was at least in part attributed to an invasion of woody species (Collier and Spillett 1973). Snell and Hlavachick (1980) reported that a colony of black-tailed prairie dogs (*C. ludovicianus*) was reduced in size from 110 acres to 12 acres by allowing cattle to heavily graze the pasture containing the colony in the early spring (thus competing with the prairie dogs for forage) and resting the pasture during June, July, and August, allowing the warm season plants to grow rapidly, creating a visual barrier to the prairie dogs.

A general decrease in grasses and an increase in brushy species has been observed in the Great Basin since settlement in the mid-1800s (Pickford 1932, Cottam and Evans 1945, Blaisdell 1953, Ellison 1960, Tueller and Blackburn 1974). Furthermore, the major foods of prairie dogs (herbaceous species) tend to decline in association with highly competitive, xerophytic shrubs such as big sagebrush (*Artemisia tridentata*), rabbitbrush (*Chrysothamnus* spp.), and various other shrubs (Ellison 1960, Collier and Spillett 1973, Tueller and Blackburn 1974). This is a result of grazing practices and fire suppression (Pickford 1932, Smith 1949). It should be noted that vegetational changes could have occurred on sites of both occupied and unoccupied colonies. Therefore, although the vegetation on colonies that were eliminated by poisons, disease, predation, shooting, or drought was conducive to prairie dog existence at the time of extirpation, it is possible that subsequent vegetational changes have taken place such that the site is no longer suitable for reestablishment of the colony.

Of the six factors affecting populations of Utah prairie dogs, two (poisoning and shooting) are prohibited because of the endangered classification of this species; man has little or no influence upon three (predation, drought, and disease); and only one of the factors (habitat change) is readily amenable to managerial control.

Efforts to transplant Utah prairie dogs onto sites of former colonies have had limited success. Elmore and Workman (1976:21) stated: "In nearly all historic dogtowns, with few exceptions, sagebrush height and density is the restricting factor for any further reintroduction of the animals." This paper presents the results of a study designed to determine if the success of transplanting Utah prairie dogs onto the site of a historic dogtown could be increased by manipulating the vegetation prior to the reintroduction of the animals.

Study Area and Methods

The study was conducted from 1978–1981 at the site of a former colony of Utah prairie dogs located on Jones Bench in the extreme northwest corner of Capitol Reef National Park in south central Utah. Jones Bench lies within a 25–31 cm precipitation belt, and the elevation is 2200 m. Vegetation on the site was dominated by big sagebrush. Blue grama (*Bouteloua gracilis*) was second most important in terms of canopy cover. Other plant species found in abundance on Jones Bench were: goosefoot (*Chenopodium leptophyllum*), tumbling orach (*Atriplex rosea*), scarlet globemallow (*Sphaeralcea coccinea*), bottlebrush squirreltail (*Sitanion hystrix*), fourwing saltbush (*Atriplex canescens*), and Yellow brush (*Chrysothamnus viscidiflorus*).

Five 5-ha plots were established on Jones Bench. Each plot represented a transplant site. Vegetation measurements were taken on the five sites prior to treatment in 1978, and after treatment in 1979 and 1980. The same measurements were taken on 10 active colonies of Utah prairie dogs located on the Awapa Plateau, approximately 35 km southwest of Jones Bench in 1978. These measurements were taken to determine differences in vegetal characteristics between occupied and unoccupied colonies. The method of vegetational analysis used was that described by Poulton and Tisdale (1961), modified only to the extent of using metric rather than U.S. standard measurements.

Four manipulative treatments were planned. They were rotobeating, railing, herbicide (2,4-D), and fire. The rotobeating was

TABLE 1. Percent cover and height of plant life forms for an active Utah prairie dog colony on the Awapa Plateau in 1978, and the Jones Bench transplant sites in 1978 (pretreatment), and 1979 and 1980 (posttreatment).

		Shrub		Forb		Grass				
		Percent cover	Height**	Percent cover	Height	Percent cover	Height	Percent bare ground	Percent litter	Percent rock
1978	Awapa Plateau	14.9	24.7	2.9	13.0	3.1	9.4	56.1	14.2	8.8
1978	Rotobeaten	19.2a*	48.3a	0.5	5.8	6.6	7.3	50.6	14.3	8.7
	Railed	18.8a	57.5a	4.1	18.2	1.1	10.5	57.5	16.0	2.5
	Herbicide	17.7a	46.1a	6.6	10.4	2.9	14.7	57.6	11.3	3.9
	Control	25.3a	49.1a	1.3	8.7	1.9	7.3	53.8	13.1	4.6
1979	Rotobeaten	1.8a	14.3a	0.5	8.7	12.5	12.0	40.0	37.3	8.0
	Railed	2.2a	20.4a	0.2	4.6	1.0	13.3	71.3	22.0	3.4
	Herbicide	4.2a	40.8ab	0.1	6.5	4.0	14.6	60.0	27.9	3.7
	Control	21.5b	45.7b	0.5	29.0	2.2	15.4	61.8	10.5	3.6
1980	Rotobeaten	6.9a	30.9a	0.1	10.3	4.3	25.4	22.6	50.3	15.7
	Railed	13.5ab	41.0a	0.3	20.8	0.7	23.1	43.7	33.6	8.2
	Herbicide	6.6a	35.8a	0.1	50.3	1.4	38.2	35.6	47.8	8.4
	Control	22.9b	59.4a	0.0	13.0	0.4	16.5	26.8	38.3	11.5

*For shrubs only, within the same year and column, means followed by the same letters do not differ significantly at the 0.05 level.
**Mean maximum height in centimeters.

accomplished by setting the blades at 10 cm above ground level in order to reduce all vegetation to that height. Railing was accomplished by bolting four medium gauge railroad rails together. This resulted in a 3.75 m long set weighing 71.4 kg per m, which is comparable to one heavy gauge rail. The site was dragged twice in opposing directions. Both the railing and rotobeating treatments were carried out in late August 1978. Attempts to achieve the fire treatment failed because there was insufficient ground cover to carry fire between shrubs. As a result, the fire treatment was dropped from the research plan. The herbicide (2,4-D) was applied by a ground sprayer at the rate of 2.22 kg active ingredient per ha with water (123 1/ha) as a carrier.

Production of herbaceous species was estimated on all transplant sites in August 1979, July 1980, and August 1981. A double-sampling scheme, utilizing a 0.89 m^2 circular plot randomly placed 60 times on each site, was used. Green weight of herbage was ocularly estimated by 3 observers with the average of the three recorded per plant. Of the 60 plots, every fourth one was clipped and the actual weights obtained for estimate correction via regression analysis. These samples were then air dried to determine percent moisture.

Measurements of the visual obstructions to prairie dogs were taken on each transplant site in 1979, 1980, and 1981, and on the site of an active colony on the Awapa Plateau in 1979. A modified version of the technique described by Jones (1968) was used. The method consists of a cover board measuring 65 × 65 cm, with 50 black and 50 white squares each 6.5 × 6.5 cm, arranged in a checkerboard fashion. Thirty readings were taken on each site by randomly placing the board at each site location in one of eight randomly chosen, compass directions. Observations were taken from a height of 30 cm, 20 m from the board. Each site had a maximal count of 3000 squares visible to the investigator. The ratio of actual number of squares counted to the total possible gave a relative percent visibility for each site.

Other characteristics were measured to assure homogeneity of the transplant sites. Measurements of soil depth to an impeding layer up to 1 m were taken on each treatment site. In addition to this, soil texture and color were determined from a soil sample taken from the surface horizon of each site. The degree of slope was estimated to the nearest five degrees for each site using a hand-held clinometer. The aspect to the nearest 1/8 compass interval was also recorded for each site. Differences in these characteristics were relatively small.

Prior to the actual transplanting, approximately 200 artificial burrows, arranged in a matrix, were dug on all sites with a power

TABLE 2. Visual obstruction measurements (30 observations per location) taken on the transplant sites on Jones Bench in 1979, 1980, 1981, and the site of an active colony of Utah prairie dogs on the Awapa Plateau in 1979.

		Location				
		Control	Herbicide	Railing	Awapa Plateau	Rotobeating
Mean	1979	2.9a[a]	7.3a	17.9a	45.5b	50.8b
percent	1980	7.1a	14.3a	11.3a	–	40.6b
visibility	1981	7.8a	10.7a	17.3a	–	44.9b
Number of	1979	21	16	10	4	0
zero	1980	16	11	7	–	1
readings	1981	18	13	11	–	0
Range in	1979	0–31	0–44	0–62	0–83	17–90
percent	1980	0–41	0–52	0–62	–	0–68
visibility	1981	0–34	0–36	0–58	–	14–82

[a]For percent visibility within the same year, means followed by the same letters do not differ significantly at the 0.05 level.

auger. The holes were dug at an angle and were approximately 9 cm in diameter and 60 to 90 cm deep. Torres (1973) reported that only when artificial burrows were dug at angles of 10 to 40 degrees was he successful in reestablishing populations of black-tailed prairie dogs in Colorado. Burrows were dug to provide the animals with temporary protection from predators and adequate thermoregulation.[4]

A total of 200 prairie dogs (50 per site) was transplanted between 16 June and 4 July 1979. The animals were trapped from five colonies located near Loa, Utah. The capture site was the same elevation as the release site. Twenty immature females, 13 immature males, 6 mature males, and 11 mature females were released on each transplant site.

One mature male, one mature female, and two immature animals were placed in three separate cages on each site. This was done to determine if temporarily holding them on the site would more likely assure their permanent location there in contrast to just releasing them on each treatment site (Salmon and Marsh 1981). The cages were constructed of 1 × 2 inch hardware cloth and measured 46 cm high, 77 cm wide, and 122 cm long. Centrally located in the screened bottom of each cage was a 30 × 30 cm hole that was placed over an artificial burrow. Caged animals had free access to water and were fed whole oats and fresh alfalfa daily. All other animals were individually released into artificial burrows located on high relief areas of their respective transplant sites.

All sites were monitored daily in 1979 for animal activity during 23 consecutive days following the release of the first animals. Monitoring took place from elevated locations around the perimeter of the transplant sites. The observer approached close enough to alert the animals (which caused them to stand erect, thus making them more visible), but not so close that they became alarmed and went below ground. Monitoring consisted of taking counts during a 10-minute time period on each transplant site during the morning.

Biweekly monitoring began after 23 days of daily monitoring. This involved taking the same counts but on two consecutive days every other week throughout the summer and early fall of 1979. In 1980 counts were taken 12–13 June and 21–22 July, and in 1981 counts were taken on 1 July (p.m.), 2 July (a.m.), and 5 August (a.m. and p.m.). The highest count obtained for each transplant site during each observation period was used in a randomized block design for evaluating the relative success of the individual transplant sites. The blocks were timed so the variance due to time was eliminated from the evaluation. Through this method it was possible to determine if significant differences occurred between the transplant sites. When significant differences did occur, multiple

[4]David F. Balph, Professor, Department of Wildlife Science, Utah State University, personal interview, 14 March 1978.

TABLE 3. Grass and forb production, and percent moisture at the transplant sites on Jones Bench for 1979, 1980, and 1981.

Transplant site	Percent moisture			Herbage production**		
	1979	1980	1981	1979	1980	1981
Railed	50a*	50a	25ab	151c	295b	203b
Herbicide	46a	55a	49bc	58a	669c	574b
Rotobeaten	45a	37a	30ab	157d	432b	317b
Control	31a	22a	26a	69b	68a	29a

*Within a column, means followed by the same letter do not differ significantly at the 0.05 level for herbage production and 0.10 for percent moisture.
**Dry weight in kg/ha.

comparisons were made using the LSD test of Fisher (Ott 1977).

RESULTS

Percent cover and height of plant life forms were considered more important than any particular botanical composition because prairie dogs are opportunists that eat any available forage that has nutritional value (Koford 1958, Crocker-Bedford 1976). Therefore, the plant species were grouped according to their life form. Pretreatment shrub height on Jones Bench is the only vegetal measurement taken that showed a significant difference (at the 0.01 level) from that of the shrub height of active colonies. This strengthened the assumption that the pretreatment vegetational height on Jones Bench was too tall for successful transplanting of prairie dogs.

The different treatments had highly varied effects upon the vegetation (Table 1). Percent cover of shrubs, primarily big sagebrush, was the only characteristic that was greatly reduced by all treatments. Shrub cover on manipulated sites differed significantly from the control, with the exception of the railed area the second year after treatment (1980). Shrub height was reduced by railing and rotobeating the first year following treatment (1979), but was not significantly reduced on the herbicide treatment because skeletons of dead plants remained intact. There were no significant differences in shrub height in the second year posttreatment because of rapid recovery of shrubs on the rotobeaten and railed sites. Shrub height on the herbicide area continued to decline slowly as dead plants disintegrated.

Table 2 shows the visual obstruction measurements. With all comparisons (in all years) only those taken on the rotobeaten site do not differ significantly when compared to measurements taken on the site of an active prairie dog colony on the Awapa Plateau.

Although the percent moisture of the herbage varied greatly between transplant sites because of wide variability among the measurements taken within each site (Table 3), significant differences (at the 0.10 level) were found only in 1981. There were significant differences, however (at the 0.05 level), in the total herbage production between the transplant sites. In 1979 all sites differed significantly from one another. In 1980 only the railing and rotobeating sites did not differ significantly, and in 1981 all sites differed significantly from the control.

Table 4 lists results of the animal counts taken during 1979, 1980, and 1981. In 1979 the rotobeating site had significantly higher numbers of animals than the other sites; there were no significant differences between the railed and other sites[5] or between the herbicide and control sites. In 1980 and 1981 no animals were observed on either the control or herbicide sites. In 1980 and 1981 the rotobeaten and railed sites did not differ significantly, but they did differ significantly from all other sites. To a certain extent, prairie dogs were more easily seen on the more open treatments, and this may have affected the counts somewhat. However, the less visible sites were carefully checked for signs of fresh diggings; when such signs were found, these areas were more closely observed.

DISCUSSION

Of the animals placed in cages in an attempt to get them to locate at the release site, all the adults had dug out of their cages within five days; one adult male dug out in

[5]Some animals moved to locations near but off the designated transplant sites.

TABLE 4. Mean numbers of animals counted on Jones Bench during 1979, 1980, and 1981.

Year	Count sites Rotobeaten	Railed	Other[1]	Herbicide	Control
1979 (n = 9)[3]	16.0c	8.1b[2]	3.3ab	1.7a	0.3a
1980 (n = 2)	13.5b(5)[4]	8.5b(3.5)	1.0a	0.0a	0.0a
1981 (n = 2)	15.0b(9)	15.5b(12)	2.0a(1)	0.0a	0.0a

[1]Some animals moved to sites on Jones Bench other than designated transplant sites.
[2]Within the same year, means followed by the same letter do not differ significantly at the 0.05 level.
[3]Number of counts taken during the year.
[4]Mean number of young counted are in parentheses.

less than three hours. On the rotobeaten and railed sites these or other animals occupied some of the cages and their underlying tunnels throughout the first summer. Immature animals were much slower in digging out; some did not dig at all for nine days, so they were released. It is doubtful that immature prairie dogs could survive if they were released in areas without burrows or adult animals to dig burrows.

The longevity of vegetational treatments is related to the amount of brush removed by the treatment (Nielsen and Hinckley 1975). The rotobeaten and railed sites will require retreatment every five to ten years. The herbicide treatment would likely not require such a short retreatment period. In 1981 there was evidence that animals may be moving onto the herbicide site. This is likely because, while other treatments are returning to their pretreatment state, the herbicide is becoming more favorable as habitat. The skeletal remains of the herbicide-killed shrubs are deteriorating; thus visibility for prairie dogs is increasing.

It may be possible to greatly reduce the need for retreatment by combining vegetation treatments. If rotobeating were to be followed in the next year or two by spraying with 2,4-D, then a higher percent kill of shrubs could be attained, as well as an effective reduction of visual obstructions. Treatment could, of course, follow the reverse sequence for the same effect.

The controlled use of fire may be the best technique to achieve the desired results where fuel loading is sufficient to allow burning. Fire, if carried out properly, could remove a high percentage of nonsprouting shrubs and increase visibility immediately at low cost. With such results it is likely that retreatment would not be necessary for perhaps 20 years or more. Fire would also release many grasses and forbs for increased growth, thus making the site even more favorable for prairie dog reestablishment through increased food resources.

The negative response of transplanted animals to the control site was a strong indication that some type of vegetal treatment is necessary when transplanting animals onto sites of former colonies presently overgrown with shrubs. The chances of a successful transplant could be increased by first reducing shrub height and cover. Our study should aid in reestablishing scattered colonies of Utah prairie dogs throughout their former range to help assure the continued existence of this unique animal. One objective of this effort is to restore sufficient healthy populations on public lands to allow for delisting of this animal as an endangered species and thus reduce conflicts on private lands by permitting local control on agricultural problem areas.

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